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DEVELOPMENT OF COST-SHARING METHODOLOGIES FOR UTILITY WORKS IN ROAD PROJECTS IN SRI LANKA

MOHAMED ISMAIL J.[1*], DE SILVA. M. L.[2] & WAIDYASEKERA, K.G.A.S.[3]
[1,2,3] University of Moratuwa, Katubedda, Sri Lanka
[1]jmismail87@gmail.com, [2]habitat.archi@gmail.com, [3]anuradha@uom.com

Abstract: Roads Authorities in Sri Lanka are obliged to pay all costs associated with relocation and betterment works required/requested by utility service providers through the funds allocated for their initiated projects. Hence, unforeseen utility-related works make transferring a substantial portion of the allocated funds for road works. In some instances, contracts for utility projects were awarded when road works were nearing completion. In addition, there were no documented cost-sharing agreements between the roads authorities and utility service providers and no sound legislation that defines their powers. This burdens the project scope and impacts the Sri Lanka economy. In this context, identifying suitable remedial measures is essential to mitigate such impacts during the design and construction stages. Hence this research aims to develop methodologies for cost-sharing of utility works to resolve the influences of road and utility projects. A qualitative research method was adopted by selecting experts for semi-structured in-depth interviews using purposive sampling technique. . The research included conducting a desktop study of international cost-sharing practices and a document review for more data collection. Hence, this study will contribute to this sector's knowledge gap to analyse the procedures and identify the areas to mitigate the utility work-related issues in Sri Lanka. It will also formulate cost-sharing methodologies for utility relocation, betterment works, and provision of new utility infrastructure in roads/infrastructure projects.

Keywords*: cost-sharing; mitigation measures; roads; Sri Lanka; utility works.*

1. Introduction

Utilities, including services, are usually referred to as basic facilities (International Labour Organisation, 2019). Services organisations supply essential utilities such as electricity, gas, water, or sewerage to the community. Infrastructure developments, such as road networks, potable water, electricity, communication facilities, and public necessities, are essential for a community's work. The problem with these projects is that they often miscalculate their financial plan and/or the time.

Developed countries such as the US, Canada, European Nations, Australia, and New Zealand have established state or provincial level laws and regulations to regulate the placement of most utilities on road reserves (Ismail, 2020). While the legislation may differ between states in these countries, they are based on similar principles—the agency responsible for the need to relocate utility infrastructure is also responsible for the relocation costs but not for betterment work (Victoria State Government, 2004). Utilities typically pay 100% of relocation costs in the United States when utilities are found in the right-of-way and are forced to divert to facilitate road project works (US Transportation Department-Federal Highway Administration, 2014). In Ontario, Canada, the Act on Highways for Public Service Works allows the road and utility authorities to decide on cost allocations mutually. In situations where no compromise exists, the expenses are equally shared. However, the disputing parties can appeal to the Ontario Municipal Board for a decision on fair cost-sharing (Transport Association of Canada, 2016). In Europe, most utilities are owned by private parties, although they serve the public, and are usually allowed to use public rights of way. When their services need to be moved to accommodate highway construction, they would typically be expected to do so at their own cost. England and Germany are just two noted exceptions. In England, utilities pay 18% of the diversion cost while the roads authority pays the rest of 82%. In Germany, the German highway authority must pay

*Corresponding author: Tel: +94 777963129 Email Address: jmismail87@gmail.com
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for the diversion when a company owns the property interest at its current location (Federal Highway Administration, 2014).

According to Asphalt Industry Alliance (2018), utility companies for road openings spend an average of £1.3 m (11%) of their carriageway maintenance budget annually. Excavating a carriageway to create a trench can decrease its structural life by up to 30%. The high utility openings in England and Wales can have damaging consequences (Asphalt Industry Alliance, 2018). The dispute will likely to delay work when the road and utility authorities disagree on diversion costs. Consequently, the road authority will provide funds as an advance for construction costs to the utility authority under an agreement called *pre-financing*. Once a court settles or determines the cost-sharing compensation, the utility authority returns any overpayment to the road authority (Federal Highway Administration, 2014).

Wijekoon and Attanayake (2010) state that relocation or shifting of utilities was the second-highest reason for delays in road project completion in Sri Lanka. According to Jayakanthan and Jayawardene (2012), delays caused by utility diversion in donor-funded projects were the 11th most influencing factor among 30 delay-causing factors identified. The Colombo Baseline project construction work was delayed by 22 months; 19 months of this was due to the relocation of utilities. This included water transmission and telecom lines (Teruo, 2005). The project cost for Phase 1 of the Base Line Road reached up to LKR 3,645 million, a substantial increase over the estimated cost of LKR 2,662 million. Reasons were the expenses incurred in the relocation of utilities, and the amount for consultancy and civil works increased due to project execution delays (Teruo, 2005).

The growing number of infrastructural development projects planned, executed, and implemented in Sri Lanka has created many issues infringing on the economic and budgetary challenges during project management (Pathiranage and Halwathura, 2010). Due to governmental or political pressure, roads and infrastructure projects were tendered and awarded for construction without adequate planning, investigation of subsurface soil conditions, and existing underground utilities (Ismail, 2020). This often results in dealing with the 'unexpected' as in most cases. Therefore, as a result, organisations will maintain the status quo of existing underground utilities by providing protection or relocating utilities and/or carryout betterment works (increase in capacity and/or size) and causing extensive delays and cost implications in the project implementation (Ismail, 2020).

In this context, Sri Lanka has severe unresolved issues and challenges relating to utility work in road projects. These issues may arise with contractors, causing additional pressure on implementers and end-users, the people whose rights have been infringed. This essentially requires identifying the utility works' impacts during the planning, designing, and construction stages. The utility relocation/betterment works procedure should focus on an in-depth study to investigate and reveal the underlying reality. However, the system cannot be addressed for the necessary improvement without proper comprehensive research and analysis. Therefore, investigating the extent of the knowledge gap in the subject is necessary to identify the areas to develop the sector by analysing the procedures. This paper presents methodologies for cost-sharing for utility relocation and the betterment of utility works in Sri Lankan road projects.

2. Impact of Utility Works on Road Project Works

The primary reason for utility diversion is that the underground utilities have neither been adequately investigated nor included in the design drawings and scope of work. They have been discovered only during the construction stage. Delays in road construction projects are inevitable since most of them commence works before the relocation of utilities. Therefore, the scope of utility relocation must be identified during the design stage, and the relocation process is initiated to avoid any delays to construction activities (Wijekoon and Attanayake, 2010). Pathiranage and Halwatura (2010) found that road construction projects in Sri Lanka exceeded the initial (planned) project period by 56-88% of the average overrun time. Although subsoil ground conditions seldom can be carefully assessed, comprehensive planning and investigations are required before construction begins (about underground utilities) to reduce the impact of any unforeseen discoveries (Pathiranage and Halwatura, 2010.

Key factors affecting the outcome of utility works include the complexity of projects, lack of information on underground utilities, lack of experience of contractors on certain types of special projects, and lack of knowledge of local regulations (Roachanakanan, 2005). Approximately 30-35% of the allocated funds for road works were transferred towards unforeseen utility-related works, and no sound legislation defines the powers, rights, and obligations of roads, utility authorities, and service providers (Ismail, 2020). The land acquisition and relocation process took nearly seven years in a Road Network Improvement Project (RNIP), two years longer than expected, resulting in about 40% of the project delay (Jayakanthan and Jayawardene, 2012).

Utility Service providers can (and do) insist on using their own consultants and approved contractors to carry out the work on their infrastructure. Changes imposed due to communication and coordination with utility authorities, delay in project site handover, approvals of drawings, method statements, and shutdown caused

significant contractual problems to Road Contractor. Huge risk resulting from unexpected site ground conditions was important and was due to several challenges and difficulties in locating underground utilities (Perera et al., 12009). Massive projects rarely follow the classic model whereby the cost is established in the early design phases. For example, years into a project and its scope may expand significantly as regulators and utility agencies demand relocation/route changes, upgrade, or additional environmental mitigations. Rigorous scope and cost management, reviewed at each stage, are necessary, but they are not sufficient. They must be paired with frequent communication with stakeholders to maintain support and avoid surprises (Matt and Joseph, 2012).

Many road projects in Sri Lanka encounter significant delays, adversely affecting the nation and economy's progress in many ways and resulting in socio-economic problems. Therefore, urgent mitigation is needed (Pathiranage and Halwathura, 2010). This is due to delays in project site handover, approvals of drawings, method statement approval, and shutdown. This leads to high risks resulting from unexpected site ground conditions and several challenges and difficulties locating underground utilities (Perera, Dhanasinghe, and Rameezdeen, 2009). Major projects seldom adopt the standards established whereby the cost is defined in the conceptual or preliminary design stages. In contrast, after construction commences, the project scope increases significantly when utility authorities require shifting services, betterment works, or adherence to environmental requirements. Critical scope and cost control should be monitored at every crucial juncture but may not be feasible. They should be coupled with regular communication with stakeholders to maintain cordial working relationships and cooperation to achieve a win-win situation (Matt and Joseph, 2012). The growing awareness in the USA of the costly practice of relocating utility services and unnecessary utility relocations not in the public's best interest led many State Department of Transports (DOTs) to avoid unnecessary relocations by adopting an engineering practice referred to as *subsurface utility engineering*. This process obtains comprehensive underground utility information. This information permits highway designers to make minor design changes to avoid various underground utilities. A recent Purdue University study revealed that State DOTs saved at least $4.62 in avoided costs for every $1 spent on subsurface utility engineering. Savings to utility companies and the public could be even more. Michael Reinke claimed (as quoted in Quiroga, 2007) that the Texas Transportation Institute (TTI) at Texas A&M University performed a variety of research for the Transportation Department of Texas (TxRA) relating to the cost of relocating utilities.

Therefore, effective coordination with the utility authorities' project team is crucial during this period to undertake the shifting of utilities without leaving the relocation in the future during the construction period (Jayakanthan and Jayawardene, 2012). Ismail et al. (2021) identified the main issues and impacts experienced in road projects in Sri Lanka, along with the proposed mitigation measures. Table 1 presents a summary of the research findings.

Table 1: Issues and their impacts experienced in Road projects in Sri Lanka

Current Issues	Impacts	Proposed Mitigation measures
• Lack of coordination and communication between road & utility authorities • No MOU to share common utility ROW corridor • Absence of a cost-sharing agreement between road & utility authorities • No corridor sharing arrangement and corridor reserve provision in ROW • Existing legal provisions not amended in keeping with current trends and practices • Misconception & mistrust • Excessive delays in approvals • Single corridor utilisation through ample provision and opportunity available to accommodate share	• Project delay • Cost implication • Time implication • Public protests & strikes • Litigation • Reduces life of new infrastructure by 30% & is a huge impact • A sharp increase in maintenance cost • In the absence of agreed standard reserved utility corridors, extensive damage caused to carriageways • Increase in abortive works • Delays in execution of works • Disruption to traffic and public inconvenience	• Enter into a cost-share agreement between road & utility authorities • Propose amendments to the existing act to suit current requirements • Introduce required regulation/s • Introduce a "Code of practice –Management of Infrastructure" in Right of Way • Establishment of a "National Utility & Road Coordination Entity (NURCE)" • Sign MOU between concerned entities • Undertake land acquisition process before project award • Develop a common corridor concept and/or corridor share between utilities in ROW

		• Establish a dedicated division /department to deal with utility works in ROW

Source: Ismail et al. (2021)

3. Current Practices of Utility Cost-sharing Implemented in Road Projects in Developed Countries

Developed nations such as the US, Canada, European Nations, Australia, and New Zealand have good practices established at the state- or provincial-level laws and regulations to regulate the placement of most utilities on road reserves, contrary to what is prevailing in Sri Lanka. It is acknowledged that each country considered during the literature survey would be able to add value to its counterparts in Sri Lanka, and the construction industry, at large. The legislation is based on similar principles though it may differ between states in these countries. The responsible agency for the need to relocate utility infrastructure is also accountable for the relocation costs but not for betterment work (Victoria State Government, 2004). Utility authorities typically pay 100% of relocation costs in the United States when utilities are found in the right-of-way and are forced to divert to facilitate road projects (US Transportation Department-Federal Highway Administration, 2014). In Ontario, Canada, the Act on Highways for Public Service Works allows the road and utility authorities to decide on cost allocations mutually. However, the disputing parties can appeal to the Ontario Municipal Board to decide on fair cost-sharing (Transport Association of Canada, 2016). England in Europe, the diversion cost paid is shared by utilities (18%) and the roads authority (82%). In Germany, the German highway authority is obliged to pay for the diversion when a company owns the property interest at its current location (Federal Highway Administration, 2014).

Cost-sharing arrangements in New Zealand have typically resulted from negotiation between the affected parties as per legislation. On state highways, for instance, gas, electricity, and telecommunication utilities are governed by the Gas Act (11), the Electricity Act (12), and the Telecommunications Act (13), respectively, within a state where the utilities are located on highways. The general law is that the New Zealand Transport Agency (NZTA) will pay for the cost of relocation of the utilities, except that the utility owner shall bear charges for all fittings (New Zealand Ministry of Transport, 1989). Suppose the utility owner wants the work done according to specifications different from those of the original works. Then, the utility owner pays the difference between the actual cost of the relocation and reconstruction and what it would have costed to relocate and reconstruct the works to their original specifications (New Zealand Ministry of Transport, 1989). Table 2 and Table 3 present cost-sharing for relocation between road and utility authorities in developed countries.

Table 2: Cost-sharing for relocation between Road and Utility Authorities in the USA, Canada, and Europe

Department of Transport (DOT) and Utility Authority Contribution to Relocation Cost			Ministry of Transportation & Infrastructure and Utility Authority Contribution to Relocation Cost			Department for Transport and Utility Authorities Contribution to Relocation Cost		
U.S.A.			**Canada**			**Europe**		
State	Utility Authority	Road Authority	State	Utility Authority	Road Authority	Country	Utility Authority	Road Authority
General	100%	0%	Ontario	Negotiable	Negotiable	England	18%	82%
New York & Alaska	0%	100%	Alberta	Negotiable	Negotiable	Germany	0%	100%
			Nova Scotia	100%	0%	Netherland	Negotiable	Negotiable
Montana	25%	75%	Quebec	50%	50%	Norway	Negotiable	Negotiable

Source: Department of Transport Report, International Benchmarking Tour (2013)

Table 3: Cost Sharing for relocation between Road and Utility Authorities in Australia & New Zealand

Roads and Maritime Services (RMS) Contribution to Relocation Cost				TMR Contribution to Relocation Cost				New Zealand Transport Agency (NZTA) Contribution to Relocation Cost		
Australia, Sydney				**Australia, Brisbane**				**New Zealand, Auckland**		
Utility Owner	Like for Like	Betterment		Utility Owner	Like for Like	Betterment		Utility Service	Motorways	State Highways
		Asset Life	Capacity			Asset Life	Capacity			
General	100 %	100%	0%	Queensland Urban Utilities	100 %	< 40 years 100%	0%	Storm-water, Sewer, Irrigation, and Water	50%	50%
								Gas and Electricity	50%	100%
Ausgrid	100 %	100%	0%			> 40 years 0%		Telecommunications	100 %	100%
Sydney Water	100 %	Proportional	0%					All Betterment Work and Fittings	0%	0%

Source: Department of Transport Report, International Benchmarking Tour (2013)

4. Methods of Cooperation, Coordination, Collaboration, and Communication of Utility Works in Road Projects

Generally, all countries included in the literature survey embrace good practices and initiatives for relocating utilities in rights of way. These are supported by legislation and/or agreements between the road authorities and the utility service providers**.** Utility work management is rarely considered in isolation but forms part of the (broader concept of) utility relocation and accommodation. This includes promoting cooperation, coordination, communication, provision of utility corridors, avoiding unnecessary utility relocations, cost-sharing of the works for relocation and betterment works, and establishing utility agreements.

A report titled 'The Management of Utilities in and adjacent to Public Right-of-Way: Survey of Practices" states the Canadian Transportation Association's findings in 2008 (the method of organising work with utility companies differs across jurisdictions). The report suggests a broad agreement on the issues of utilities facing road authorities, including disruption and increase in costs to road projects caused by the following utility diversions:

- Utilities "as-built drawings" data and site location details of existing underground assets are often inaccurate and of poor quality
- When utility service providers excavate or cut newly-laid road carriageways, there is the additional burden of the cost incurred by road authorities due to the reduced road service life
- A significant effort is needed from all concerned stakeholders to ensure a reasonable cost-share of all utility-related works within the right-of-way

In 1998, a Federal Highway Administration (FHWA) research found the lack of cooperation, communication, and coordination to be the most critical utility-related challenges and problems. The Utilities Division of the Montana Department of Transportation's (MDT) Right-of-Way Bureau works in conjunction with utility companies to identify relocation alignments, create cost-sharing agreements, and provide guidance on issues and works directly with utility companies (US Department of Transportation-Federal Highway Administration, 2014).

5. Research Method

The first step of the research process was a wide-ranging literature survey covering the impacts of utility works on road project works. Current practices available in roads and transportation authorities of developed countries, particularly relating to utility works in road projects, were also explored. Literature survey evidence was primarily

obtained by referring to journal articles, books, conference proceedings, reviews of road management/ thoroughfare acts, code of practices for road and utility work in the right of ways, industry reports, and documents from Sri Lanka and overseas.

Secondly, by adopting a qualitative research method, purposive samples were selected from experts for semi-structured in-depth interviews with key team leaders, i.e., specialists of roads authorities (RA), utility authorities (UA), and other applicable government entities in Sri Lanka and overseas. It aimed to identify their proficiency in design, execution, and advice in roads, infrastructure, rail, and utility projects. The relevant government, semi-government, and private institution officials' expertise were scrutinised thoroughly to form the requisite conclusions for the qualitative approach, the appropriate policy, and the legal framework. Twelve (12) in-depth interviews were held with senior advisors, project directors, general managers, senior project managers, legal experts, and team leaders representing roads, utilities, transportation, and light rail authorities. The interviewed participants were highly experienced practitioners representing those fields, enriched by new information in line with their respective fields, current practices, and procedures. They all had an average of over 25 years of experience in their professional areas. Table 4 presents the respondents' details.

The assembling of data includes a technique that produces qualitative data to be analysed. As per Westbrook (1994), content analysis is a leading data analysis mechanism that analyses qualitative data, which provides reliable logical implications from the given data. Further, Hsieh and Shannon (2005) stated that the content analysis technique is applicable for text data that will absorb, summarise, and define the content.

The qualitative data collected from multiple sources were analysed based on semi-structured predetermined questions. After transcribing, transforming, and arranging, the collected data were organised and arranged in an orderly manner based on research objectives. Next, proper codes for the collected data were arranged to compress a large amount of collected information. Qualitative data coding means categorising and assigning properties and patterns to the collected data. Findings were summarised, and recommended options and viable solutions were identified.

Table 4: Details of Respondents

Respondent	Profession/Designation	Industry Experience	Level of Awareness / Experience in Practice
REI	Director-Design	31 years	High
RE2	DGM-WPS2	33 years	High
RE3	Project Director	28 years	High
RE4	DGM-NCP	25 years	High
RE5	Director - Legal	30 years	High
RE6	AGM- Development	28 years	High
RE7	Project Manager	08 years	Moderate
RE8	Senior Advisor-Major Projects	30 years	High
RE9	Director-Engineering	35 years	High
RE10	Chief Engineer	15 Years	High
RE11	DGM /Project Director	35 Years	High
RE12	Project Engineer	08 Years	Moderate

6. Research Findings

A literature survey, document review, and data collected from semi-structured expert interviews provided research findings. More details discovered through semi-structured expert interviews are discussed below.

6.1 COST-SHARING OF UTILITY RELOCATION AND BETTERMENT WORKS IN ROAD PROJECTS IN SRI LANKA – STATUS QUO

The approach to cost-sharing differed significantly between the states in the United States and Canada and similarly between the European Countries. New Zealand and Australia have laws and regulations at the state/city level that govern the accommodation of utilities within road reserves. They are based on similar principles, and the application is primarily consistent throughout the respective countries. Currently, Sri Lanka has no agreements that outline or facilitate cost-sharing concerning the relocation of utility infrastructure among Roads Authorities and Utility Owners within the country.

This study summarises that cost-sharing is rarely considered in isolation; instead, it formulates a part of the broader concept of utility relocation and betterment works. Such works include promoting cooperation, coordination and communication, the provision of utility corridors, avoiding unnecessary utility relocations, and establishing utility agreements for achieving the common goal of providing the best value for money solution to the client with the least disruption to the public.

6.2 PROPOSED COST-SHARING MEASURES TO REDUCE THE IMPACT OF UTILITY WORKS IN ROAD PROJECTS IN SRI LANKA

Most respondents emphasised an urgent need for and the importance of establishing a new organisation under the title of "National Utility & Roads Coordination Entity (NURCE)", representing roads and utility authorities. Literature findings revealed similar entities in operation in the US, Australia, New Zealand, and UAE (Department of Transport Abu Dhabi, 2013). This entity will immensely benefit all stakeholders in sharing current, near, and long-term master plans. It will also assist in solving issues in projects related to planning, designing, and construction stages.

The other aspect is establishing cost-share agreements between all stakeholders for relocation and betterment works across the board, initially for three years, instead of the current ad-hoc agreements. The response showed that the word 'cost sharing' had different understanding levels, not merely in terms of utility relocation for betterment works. Respondents (RE1, RE3, RE4, RE6, RE9, RE10, and RE11) stated that none considered educating the enormous benefits and contemplated its legislation due to the technical nature of the construction industry.

The literature review revealed that all developed countries, including Australia and New Zealand, apply cost-sharing measures for relocation or the betterment of utility works (Victoria State Government, 2004). Developing such a standard or an approach is not complicated but needs collaboration, coordination, and teamwork. There is no standard approach to determining the cost, but many good practices and suitable methodology are already in place and practised successfully.

Most respondents added that the site investigation process was made after awarding road contracts. This raises many fundamental and severe contractual disadvantages regarding financial, project delivery, and several other indirect costs to the economy and the general public. Respondents (RE10 and R11) added that a special clause, in particular to the road contract conditions, to be inserted to reduce the impact of utility relocation, clearly identifying the parties' responsibility to the contract. A respondent (RE8) stated that allocating a dedicated reserved corridor within the Right of Way (ROW) from the inception of the design stage will be another way to eliminate such impacts.

This may be impossible in a fully-developed ROW in a densely populated area or in a commercial area where the possibility of an entire corridor would have been already utilised. In such circumstances, the road authority may grant conditional permission to obtain an undertaking letter confirming their unconditional acceptance to relocate their assets to desired location free of charge when requested during road widening or any other infrastructure development. Respondent RE4 suggested laying electricity and telecom cables in a common single trough to share costs and standardise the corridor conflicts. RE4 further pointed out another cost-share concept (a similar observation made in Japan): to implement the erection of both electrical and telecom cables in a 14 m tall standard pole where the top part is assigned to electrical cables.

Respondent RE3 added that the land acquisition process should commence well before beginning road projects, with an attractive compensation package to landowners. Most respondents acknowledged the need for ongoing communication and cohesive planning by sharing information about their short and long-term project proposals and work programmes to allocate and secure utility corridors within the Right of Way. This should balance road use, utility requirements, and other community needs. Most respondents opined on avoiding unnecessary re-digging of the same road, recognising the overall need for cooperation, efficiency, and effectiveness in delivering the works, and managing their respective assets to minimise potential project delays. Two respondents (RE1 and RE8) stated that allocating a dedicated reserved corridor within ROW right from inception during the design stage will be another way to eliminate such impacts.

Therefore, the best method of cost-sharing principles and apportionment for Sri Lanka Roads and Utility Authorities are concluded based on current good practices implemented in developing countries and the feedback received from most respondents, as follows.

Calculation of Cost-Sharing Apportionment

The proposed cost-sharing apportionment is as follows:

A. Cost of Betterment to be **paid wholly by the Utility owner,** where:

Cost of Betterment = Total Cost of New Asset – Cost of relocating/replacing Like for Like Asset

B. RA contribute to the cost of relocating or replacement of like-for-like using the formula:
RA Contribution =

$$\left(\textbf{Cost of relocating or replacing Like for Like Asset x } \frac{Remaining\ Asset\ Life}{Total\ Asset\ Life}\right) - Salvage\ Value$$

Finally, Table 5 presents the matrix to reflect the instances in which the above two cost-sharing formulas are applied.

Table 5: Proposed Cost-sharing Principles

ACTIVITY	IMPACT ON ASSET	CURRENT-INITIATOR SHARE (RA)	PROPOSED-INITIATOR SHARE (RA)
RELOCATION			
Relocate utility with existing material	No Impact	100%	100%
BETTERMENT			
Relocation with new material	Increase Asset Life	100%	Cost Share
Relocation and upgrade with new material	Increase Asset Life	100%	Cost Share
	Increase Capacity	100%	0%
New Works	New Asset	100%	0%

The research study concludes that adopting the following key elements is vital for successfully implementing road and utility projects.

- Involve utility authorities as early as possible within the design phase of road projects,
- Establish cooperation, coordination, and communication wherever deemed necessary to reach upfront agreements, and
- Cost-sharing obligations and dispute resolution processes to achieve the common goal of providing the best value for money solution to the client with the least disruption to the public.

Many respondents highlighted that accurate utility service records are essential to constructible designs. In congested rights of way, and/or when record accuracy cannot be accepted as reliable, the trial trenches should confirm the location of services as part of the design phase. Moreover, the study revealed that agreement should be reached between stakeholders on a holistic basis for an agreed fixed term, say 3 to 5 years, rather than the project-by-project basis to include significant aspects based on past experiences.

Advance implementation of pre-construction utility shifting and/or under the current RDA Act 73 of 1981 and National Thoroughfares Act No. 40 of 2008-Section 26 (5): the provision in the law should be implemented before the commencement of Road Projects to avoid drawbacks including economic and financial losses, and disadvantages such as multiple contractual implications and huge payments due to time extension, prolongation cost, arbitration cost, etc.

6.3 PROPOSED RECOMMENDATIONS AND THE WAY FORWARD

Following recommendations were derived through interviewees' findings.

6.3.1. Establishment of a National Utility & Road Coordination Entity

It is recommended that an independent Utility/Road Coordination Entity be established within Sri Lanka to foster a cooperative environment for the roads authorities and utility authorities to offer their services. This may be a new entity with the power to steer the above recommendations. It is imperative that pursuing the above initiatives has the endorsement and full support of the Government's top management structures. Assuming such endorsement is provided, it is proposed that the above be undertaken in a phased approach for everyone to get oriented.

6.3.2 Legislative Provision for Cost Sharing of Utility works in ROW

Sound legislation will define the powers, rights, and obligations of all transport and utility authorities and service providers. MOUs have been developed for particular project/s between the road authorities and some utility service providers to promote cooperation, coordination, communication, and effective dispute resolution methods. Necessary legislative provision for cost-sharing of utility works in ROW shall be initiated by choosing methodologies most suitable for Sri Lanka. In the absence of legislative provisions and laws concerning cost-sharing and by-laws,

currently, the utilities lack a proper procedure and processes for dealing with utilities in road projects. Based on the interviewees' findings, a necessary amendment to National Thoroughfares Act No. 40 of 2008-Section 26 (5) is needed to solve current challenges.

6.3.3 Recovery of Costs

The potential rise in project costs and delays arises from the delay of road projects by local utility authorities because of infrastructure disputes, no objection permit approval problems, or right-of-way corridor issues. It is recommended that the RA take steps to ensure that governments continue to recover these expenses where liability is established and economical.

6.3.4 Sharing of Lessons Learnt

There are no *lessons learnt process* or *lessons learnt document* to record all critical and vital information for planning future projects. Challenges such as the problems encountered, causes of cost and time overrun, and utility and management issues were not shared or discussed in an exclusive seminar to disseminate the knowledge, particularly on what went wrong or what could be better. For example, what could be better than that if it was better? These questions were not discussed, specifically after completing Colombo–Katunayake Expressway to share the knowledge with similar projects, e.g., Southern or Central Expressway.

6.3.5 Advance Utility Relocation and Betterment Works

A special project should be implemented exclusively for land acquisition, utility relocation, and betterment works through donor-funded road projects. The operation of this project should start work approximately two years before commencing the main road project. The land acquisition and resettlement must be initiated immediately after feasibility studies provide the "go ahead" sign.

6.3.6 Trial pits details and digitised as-built details

Most Utility Authorities do not possess accurate as-built drawings of their existing utilities. Hence, past project findings, i.e., digitised as-built information, should be freely made available to all concerned, including RA and UA.

6.3.7 Utility Management as a Major in Universities

One respondent (RE8) highlighted that the Transportation Research Board-Washington DC conducts an annual conference in February. A resolution was adopted for the first time in Washington on 'introducing a new major in university such as utility engineering' because this field is critical to the construction industry, and the impact of utilities is vast. The core project/business gets delayed if the issues related to utilities are mishandled in any project. Since utilities' relocation is vital for road construction, introducing utility management/engineering, either as a major or at least as an elective subject in universities, will benefit contractors, consultants, government agencies, project managers, and project quantity surveyors.

6.3.8. Agreements and MOUs between Roads and Utility Authorities

The respondents highlighted that current agreements and Memorandum of Understandings (MOUs) between Roads and Utility Authorities are executed only for specific projects or ad-hoc basis. The MoU signed by all authorities includes limited provisions such as methodologies, approaches, procedures, and processes requirements. It is recommended that the RA take the initiative to encourage the establishment of MOUs between the RA and utility service providers to promote collaboration, teamwork and communication, create conflict resolution mechanisms, identify cost-sharing arrangements for relocation/betterment works, and relieve the RA from the full burden of funding utility relocations from within its budget. This allows the RA to spend less on relocation and more on roads and infrastructure delivery.

6.3.9. Road Management Act 2004 - Code of Practice as a guide to Sri Lanka

Based on the findings from the documents review it is highly recommended Sri Lankan authorities to get guidance from the Road Management Act 2004 - Code of Practice by the Victoria Government of Australia.

The Victoria Code of Practice – Management of Infrastructure in Road Reserves (Code) - provides good practice guidance on how road authorities and utilities can cooperate to manage road infrastructure and utility infrastructure within road reserves. This code, developed by a working group representing road authorities and utilities and other key stakeholders, provides a wide range of guidance on the planning, construction, and maintenance of utilities in road reserves; clause 62 refers to considering possible cost-sharing arrangements between road authorities and utilities.

7. Conclusions

Overall long-term agreements are not currently available amongst road authorities and utility owners that outline or facilitate managing utility works during road project work within Sri Lanka. This paper summarises wide-ranging recommendations and several remedial measures to mitigate the impacts of utility works. It includes promoting

cooperation, coordination and communication, providing utility corridors, avoiding unnecessary utility relocations, and cost-sharing agreements, predominantly for utility relocation and betterment works.

Implementing a development collaboration methodology is recommended to tackle better cooperation with road and utility authorities. Among other issues, they may be held accountable for any subsequent rise in project costs and delays when road authorities cancel/reduce the project scope due to utility, infrastructure issues, environmental problems, or right-of-way efforts. When implementing a road project, the executing entity should be advised to maintain close communication with stakeholders to prevent unnecessary delays caused by poor coordination, avoid unnecessary re-digging of the same road, recognise the overall need for cooperation, efficiency, and effectiveness in the delivery of the works, and the management of their respective assets to minimise potential project delays. Sound legislation will define the powers, rights, and obligations of all transport and utility authorities and service providers. MOUs must be developed between the road authorities and utility service providers for 5-8 years to promote cooperation, coordination, communication, and effective dispute resolution methods. Legislative provision for cost-sharing of utility works in ROW should be initiated by choosing the most suitable methodologies for Sri Lanka and identify and formulate cost-sharing of utility relocation and the provision of new utility infrastructure between road authorities and the respective utility owners based on material type, age of utility, and life span with the option to benchmark good practices from developed countries.

It was noted that cost-sharing is rarely considered in isolation but forms part of the broader concept of utility relocation and accommodation. This includes promoting cooperation, coordination, and communication, providing utility corridors, avoiding unnecessary utility relocations, and establishing utility agreements. No agreements exist that outline or facilitate cost-sharing concerning the relocation of utility infrastructure amongst road authorities and utility owners within Sri Lanka. The paper provides a few recommendations for industry stakeholders and policymakers.

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